OBITUARY NOTICES

OF

FELLOWS DECEASED.

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William Codling

WILLIAM ODLING, 1829-1921.*

In William Odling passed away the senior scientific Fellow of this Society. Elected sixty-two years ago, he may be said, like Nestor, to have lived through three generations of warring men; a front-rank fighter among the first, a member of the general staff during the second, an interested observer and wise counsellor at the end.

Perhaps the military metaphor which would best describe Odling's position as a young man in the great advance of international science, is that of interpreter and liaison-officer. The translator of Laurent's 'Chemical Method,' the pupil and enthusiastic disciple of Gerhardt, he formed one of the active band who developed the Theory of Types—a theory which brought with it, as a natural consequence, the recognition of the Rule of Avogadro, and thence the revision of the Atomic Weights, and led to the conception of Valency, and thence to the Periodic Classification of the Elements.

It was fitting that the Chemical Society, in celebrating its Jubilee in 1891, should have selected Odling to deliver an address on the chief developments of Chemical Theory since the foundation of the Society, and that he should have laid stress on the far-reaching effect of the work of Gerhardt and Wurtz, of Kekulé and Hofmann, of Williamson and Frankland, to the development of which he rightly claimed to have contributed "some little" share.

The son of a medical man, George Odling, practising in Southwark, William Odling was born there, September 5, 1829. In order to follow his father's profession, he entered, in 1846, Guy's Hospital, where he studied Chemistry under Dr. Alfred Taylor. In 1849 he passed the 1st M.B. of London University, gaining gold medals in Chemistry and in Materia Medica and Honours in Physiological Botany; and in 1851 he graduated M.B., obtaining Honours in Physiology and Comparative Anatomy. In the previous year he had been made Demonstrator in Chemistry at Guy's by Dr. Taylor, under whom he continued to work until elected Professor of Practical Chemistry. This chair he held until he succeeded Frankland as Lecturer in Chemistry at St. Bartholomew's in 1863. In 1848, in his twentieth year, he was elected to the Chemical Society, and seven years later he became one of the two secretaries; in 1869 he was made a Vice-President, and from 1873 to 1875 he served as President. At the time of his death he had been a member of the Council for an unbroken period of sixty-five years.

* For several particulars in this Notice the writer has to acknowledge his indebtedness to the excellent and full account of Dr. Odling's life written for the Chemical Society by one of Odling's assistants, Mr. J. E. Marsh, Fellow of Merton College, Oxford, who writes (November, 1921) that he has just seen a record of Odling lecturing on chemistry to his school-fellows while still at school.

Although he gave some assistance to his father, he does not appear to have contemplated making a practice for himself, and, with the exception of carrying out the duties of a Medical Officer of Health, he confined himself to pure and physiological Chemistry.

In 1854 he published his first book, 'Practical Chemistry for Medical Students,' and in the following year became known as the translator and editor of Laurent's 'Chemical Method,' and—through his first lecture at the Royal Institution—as a gifted exponent of the new doctrines.

In translating Laurent, the two-volume system of Gerhardt (finally adopted by his colleague) was used systematically by Odling. "The distinction," he writes in his preface, "between the system of equivalents ordinarily adopted in this country, and the two-volume notation adopted in this work, may thus be expressed. In the new system the atomic weight of carbon is 12, of oxygen is 16, of sulphur is 32; all the other atomic weights are unaltered."

By this method the modern formulæ for water, ammonia and methane were introduced, and they carried in their train the correct formulæ for many simple bodies; but the dyad metals were still written with their "equivalent," *i.e.*, with half their modern atomic weights. In his 'Manual of Chemistry,' published in 1861, he still adopted the same formulæ, and this may be one of the reasons why the Manual was never completed. Under the influence of Williamson, he became converted to the complete reform urged by Cannizzaro, and for many years he was one of the chief expounders of the "New Chemistry."

In 1868 Odling was appointed Fullerian Professor of Chemistry at the Royal Institution in succession to Faraday, and a number of his contributions to Science are in the form of abstracts of his discourses delivered at the Institution. In 1872 he was elected Waynflete Professor of Chemistry at Oxford, in succession to Sir Benjamin Brodie; he held the chair for forty years, until his resignation in 1912. In 1883 he became President of the Institute of Chemistry, which obtained its Charter during his term of office, largely owing to his advocacy.

His presidential address to the Institute gave rise to some sharp criticism. It was the time when the cry for the endowment of research had been taken up in many quarters, and Odling maintained that the discipline of having to earn one's daily bread is wholesome, and is no impediment to the achievement of the highest things—and that the best of all endowments for research is that with which the searcher succeeds in endowing himself. It was easy for him to instance many chemists distinguished in research, who—like Odling himself—had obtained success as expert advisers and witnesses, or, to use his own phrase, had reached "professional eminence"; but it was perhaps unfortunate that he should advise the young men of the Institute to pursue research for which many of them "in the seed-sowing time of their life" would be willing to make "considerable professional sacrifices." Such phrases were, of course, fastened on, and even given a personal reference.

Odling replied, with some excusable bitterness, that he was addressing a body of *professional* chemists, and not proclaiming to students "the whole duty of a chemist."

At Oxford Odling maintained his reputation as a lecturer. He aimed at systematising and co-ordinating the researches of others, and bringing them into their place in an ordered system. He was not without aptitude for and skill in experiment, but the experimental side of chemistry did not appeal to him. The laboratory was provided with a University teacher—the Aldrichian Demonstrator—and Odling brought with him another demonstrator, and to these the practical instruction of students (and their fees) were assigned; it was not etiquette, Odling said, for the Professor to enter the Chemical Laboratory.

This was a set-back from the practice and example of Brodie, who, from his appointment in 1855, had been busy with his own hands, and had guided and encouraged his assistants to undertake researches of their own. It was not that Odling *discouraged* research: on the contrary, he was glad to help and give facilities to research workers, and his well-stored memory was often useful in recalling what had been done in foreign (especially French) laboratories. To show that important work was done in his laboratories, it is only necessary to recall the pioneering researches of F. D. Brown on the theory of fractional distillation, and the investigations of J. E. Marsh on camphor and the terpenes. But the fact remained that Odling founded no school—to which charge he might plead that it was not his *métier* to do so; that he had been elected, not as an experimenter, but as an exponent of chemical theory, and that he had been true to his past record.

At Oxford Odling took an active part in University affairs and served on the Hebdomadal Council for 15 years. He spoke incisively and well in Congregation, and for his successful opposition to one proposal he should be gratefully remembered by Oxford men of Science. The difficulty of "Compulsory Greek" was already being felt, and in 1879 a plan was put forward to get round the difficulty by creating a new degree in Natural Science, which might be obtained by science students without passing in Greek.

The new degree opened no avenue to the M.A. degree, and therefore debarred the holder from being a member of Convocation—the governing body of the University. This privilege was reserved for the B.A.—the man who had, or once had had, the necessary smattering of Greek—for "Greek," as Canon Liddon urged in the *Times*, "imparts those habits of exactness and refinement, without which it is impossible to reach the higher characteristics of an educated man." Odling's common sense had little difficulty in refuting these arguments, and in persuading his Oxford colleagues to reject the proposal: it was better to endure compulsory Greek—however useless for culture the smattering required might be—than lower the dignity of the school of Natural Science. Compulsory Greek, as all men know, died hard at Oxford, but Odling lived to see the end.

It was in 1875 that the writer, then an undergaduate, first attended Odling's lectures in the Oxford Museum, and had the privilege of meeting, at his house in Norham Gardens, Hofmann, Frankland and other chemists. His lectures were possibly more appreciated by graduates—college tutors and coaches—than by those in *statu pupillari*; the writer certainly appreciated them more when he in turn became a teacher.

Odling's lectures were always attractive—as good summing-up is attractive. The arguments were marshalled with admirable precision, the reasoning was clear and convincingly given, the scope of the discourse strictly confined to the matter in hand. Here was the dry light of Science permeating an abstruse problem, where no human element, no clash of personal views, no stimulating conjecture, no "thinking aloud" seemed to be in place. His hearers felt that the "thinking" had been done beforehand, and that what they were listening to was the considered judgment of the court.

In symbolising constitutional formulæ most men look for some design by which the parts are mechanically joined; but to Odling this seemed unnecessary and misleading. Hence the mechanical bonds of Frankland became in Odling's notation mere dots or dashes attached to an atom or radical, marking what he called its "desmicity" or combining power. Odling, indeed, was a little bitter on the misuse of "bonds" in graphic notations. "Such a system," he writes in the preface to his 'Outlines,' "used to express with equal confidence the ascertained and unascertained constitution of all bodies whatsoever, has I believe exerted and still continues to exert a most prejudicial influence on the study of Chemical Science, by making the fanciful sticking-together of variously pronged discs of more importance than the investigation of phenomena."

The Type Theory, which owed so much to Odling's powerful advocacy, became in his mind something far more fundamental than a conventional mode of regarding chemical combinations. The types themselves—water, ammonia, methane—by reason of their composition and structure, were endowed with certain enduring properties that were retained by their derivatives. While the setting up of imaginary structure was freely practised by chemists, the possibility already existed of determining *relative* structure—"of making out that in one body the structural arrangement is similar to, or different from, that of another and usually more simple body." Here is a sentence from a Royal Institution Lecture of 1869; there could be no mistaking the speaker:—"Marsh-gas is transformable into methyl chloride by the action of chlorine; and methyl chloride into marsh-gas by the action of hydrogen. From this mutual metamorphosis, and from the parallelism of their properties, formations and transformations, the two gases are inferred to have one and the same molecular structure, whatever that may be."

Believing, as Odling did, that the structure of molecules was un-ascertainable, or at all events not yet ascertained, he abstained from structural formulæ and relied on similarity of reactions to indicate similarity of composition. Thus in the "Outlines" we find his much-quoted formula for

bleaching powder introduced by a simple analogy without further explanation. Just as chlorine acts on the hydrate of a monad metal to form a molecule of the chloride and a molecule of the hypochlorite :—

$$\begin{matrix} \mathrm{NaOH} \\ \mathrm{NaOH} \end{matrix} + \mathrm{Cl_2} = \mathrm{NaCl} + \mathrm{NaOCl} + \mathrm{H_2O},$$

so chlorine acts on the hydrate of the dyad metal calcium to form a condensed molecule—half chloride and half hypochlorite :—

$$\mathrm{Ca''}\left\{\begin{matrix} \mathrm{OH} \\ \mathrm{OH} \end{matrix}\right. + \mathrm{Cl_2} = \mathrm{Ca''}\left\{\begin{matrix} \mathrm{Cl} \\ \mathrm{OCl} \end{matrix}\right. + \mathrm{H_2O}.$$

The simple explanation of Andrews' work on the molecular constitution of ozone was given by Odling in his "Manual," published the year after the 'Phil. Trans.' memoir by Andrews. If ozone is a compound of oxygen with oxygen and the contraction be consequent on their combination, then if one portion of the combined oxygen were absorbed by the reagent, the other portion would be set free and by its liberation might expand to the volume of the whole. Thus if we suppose three volumes of oxygen to be condensed by their mutual combination into two volumes, then on absorbing one-third of this combined oxygen, the remaining two-thirds would be set free, and consequently expand to their normal bulk, or two volumes :—

$$\overset{\text{2 vols.}}{\overset{-}{\mathrm{O}}\,\overset{+}{\mathrm{O}}\,\overset{-}{\mathrm{O}}} + \mathrm{Hg_2} = \overset{+}{\mathrm{Hg_2}}\overset{-}{\mathrm{O}} + \overset{\text{2 vols.}}{\overset{+}{\mathrm{O}}\,\overset{-}{\mathrm{O}}}.$$

In his Oxford lectures hydrogen was no longer the *quasi* metal imagined by Graham; it was the "vanishing point of the hydrocarbons," and would resemble them on liquefaction.

Again, the benzene hexagon of Kekulé, and the structural derivatives of Körner and others, became in Odling's hands two superposed triangles, each of three carbon atoms, flattened for representation into two lines :—

1	2	3
4	5	6

Odling's views on the relation of the elements as revealed by their atomic weights were much in advance of those of his contemporaries, and led him almost within sight of the Periodic Law. With his strong regard for analogies, he clearly marked out the parallelism of successive groups or "families" of elements, and in comparing, for instance, the carbon with the nitrogen family, he plainly showed that a tetrad element was missing, with an atomic weight about 72, corresponding with arsenic (75) in the neighbouring group. This prediction of germanium was made long before Mendeléeff's periodic classification was known in England.

The question of the position of aluminium in the natural classification of the elements led to the preparation of aluminium methide and ethide by Buckton and Odling, in order to determine the vapour density of some volatile compounds of the metal. Following a suggestion of Cahours, they prepared the two compounds by heating aluminium with the methide and ethide of mercury in sealed tubes at 100° C. The aluminium ethide boiled at 194°, and its vapour density was found to be 4·5 (compared with air) at 234°, the formula $AlEt_3$ requiring 3·9, and the double formulæ, Al_2Et_6 requiring 7·8; similarly, aluminium methide had a vapour density 2·8 at 240°, the theoretical value for $AlMe_3$ being 2·5. It was found that the vapour density increased with diminishing temperature, and the vapour density of the methide, determined near its boiling point (130°), was 4·4, approximating to the theoretical density for Al_2Me_6. This increase of vapour density explained Deville's results with aluminium chloride, and the research showed the essentially triad character of aluminium.

Another research on anomalous vapour densities, though it does not appear that he published it, was due to Odling. The vapour density of calomel was found to correspond to the simple formula HgCl—a fact which contradicted the law of odds and evens (Odling's Perissads and Artiads). The chemical depravity shown by vapourised calomel is shared by other compounds (nitric oxide is a notorious offender), and we have learnt to be more lenient in our judgments; but in the early days of the new chemistry such conduct was anathema and had to be explained away. Odling showed by suspending gold leaf in the vapour of calomel that mercury amalgamated with the gold, and the anomalous vapour density was explained by the dissociation of the real molecule into mercury and the higher chloride:—

$$Hg_2Cl_2 = Hg + HgCl_2.$$

Concerning the anomalous vapour density of ammonium chloride, Odling disputed the "ammonium" theory, and argued that ammonia maintained its identity and formed a molecular compound with HCl, just as it did with AgCl, and the two compounds were broken up on heating in the same way. Why, asked Odling, should the chlorine atom leave the hydrogen atom, for which it has such a strong affinity, to attach itself to the nitrogen atom, for which it has so little? The chlorine does not do so, replied Williamson, but it leaves *one* hydrogen atom to attach itself to a nitrogen atom holding *four* hydrogen atoms together; the group containing four hydrogen atoms has greater attractions than a simple atom

But though Odling might sometimes carry an analogy too far, there can be no question of the effective use he made of the weapon. Few of his students can forget the convincing way he pleaded for the "normal" character of ortho-silicic acid. Compare the normal hydrides of chlorine, sulphur, and phosphorus, formed on the three well-established types, and consider the acids formed from them by the fullest oxidation:—

$$HCl \ldots\ldots HClO_4; \quad H_2S \ldots\ldots H_2SO_4; \quad H_3P \ldots\ldots H_3PO_4.$$

These are the normal fully oxidised, or ortho-acids: must not the hydride of silicon have a corresponding normal ortho-acid :—

$$H_4Si\ldots\ldots H_4SiO_4\ ?$$

This was the basis on which Odling built up a classification of the silicates, parallel with the ortho-, pyro-, and meta-phosphates. Odling, when examining *vivâ voce,* once asked a candidate what he meant by a "normal acid," and the prompt reply was, "Ortho-nitric acid, H_3NO_4, is a normal acid." To this the examiner remarked, after a pause, "I cannot contradict you."

In 1872 Odling married Elizabeth Mary, daughter of Alfred Smee, well known as the inventor of Smee's cell, and perhaps more widely known as the author of 'My Garden.' Mrs. Odling died two years ago, and three sons of the marriage survive their parents, the eldest having added his grandfather's name to his surname.

Odling resigned the Waynflete Chair in 1912, after a tenure of 40 years; he was succeeded by Dr. W. H. Perkin, F.R.S., Professor of Organic Chemistry in the University of Manchester.

It was his privilege to be a guest at two Jubilee banquets given by the Chemical Society to the Past-presidents who had been Fellows for 50 years; the first in 1898, when he was ranked in the toast with Williamson and Frankland as one of the founders of the New Chemistry; and again, in 1910, when, as the *doyen* of the Past-presidents, he asked to speak after his younger colleagues—Roscoe, Crookes, Hugo Müller, and Vernon Harcourt—had replied. All these colleagues he survived, and almost lived to hear—this year—a third generation answering to their Jubilee toast. He kept up a keen interest in Science to the end.

H. B. D.

ALEXANDER MUIRHEAD, 1848-1920.

Alexander Muirhead was born in 1848, the second son of John Muirhead, a farmer in East Lothian. At the age of three his nurse fell when carrying him, and he received a blow on the head which made him permanently, though partially, deaf. As a child he was thought rather stupid because he wished to know the reason of everything before doing it, and an experiment recorded against him is the planting of a toy spade in the garden in order to grow a second one.

His father, while still a fairly young man gave up farming, brought his young family to London, and started telegraphic work, with Mr. Latimer Clark as partner, in Regency Street, Westminster. Young Alexander now went to University College School, Gower Street, where he soon began to carry off prizes. Chemistry came to him very easily, and he went on to the College, where, in mathematics, he had the advantage of the teaching of De Morgan, of whom he became a devoted pupil, and by whom he was imbued with the spirit of accuracy. He often spent his school half-holidays in his father's works, where he sometimes felt the inspiration of seeing Clerk Maxwell and Sir William Thomson.

Instead of going to Cambridge, his father sent him to study Chemistry under Dr. Matthiessen at St. Bartholomew's Hospital, but before his pupilage had expired, Mr. Latimer Clark borrowed him to work out the problem of a cell for standard voltage in the firm's laboratory. This was the beginning of an immense amount of accurate work in connection with electrical standards, and he may be said to have inaugurated the standards of Capacity. He graduated B.Sc., with honours in Chemistry, in 1869, obtained the Doctorate in 1872 in Electricity, and began a life-long friendship with Prof. Carey Foster. He now became scientific adviser to his father's firm, where John Perry and some others also worked as his assistants, because at that time it was the centre of accurate pioneering work in practical electrical measurement in association with Charles Hockin and others.

In 1875 Dr. Muirhead invented his artificial line with distributed capacity, and succeeded in the notable achievement of duplexing cables; his own personal experimental work being done chiefly at Aden. After this success, he initiated a private laboratory for research work, first in Cowley Street, Westminster, and afterwards near Storey's Gate. Here he perfected his electrical standards; and about 1896 he began the manufacture of instruments at Elmers End.

In 1894 his attention was directed to the possibility of telegraphy by means of Hertzian waves, through hearing a lecture at the Royal Institution in May of that year; and work was done for years at Elmers End towards the development of this subject, especially in the obtaining of messages recorded on siphon-recording tape, instead of being merely heard in a telephone.

Accurate tuning was subsequently accomplished, and disturbances from neighbouring experimental stations were eliminated, partly by the avoidance of earth connection; a subject on which a paper was communicated to the Royal Society in 1909 ('Roy. Soc. Proc.,' A, vol. 82, pp. 240–256). It was possible not only to hear, but automatically to record messages from a distant station while another sending station was active within about a hundred yards of the receiver. Automatic receiving is a severe test, since a machine does not discriminate and ignore, as a human receiver can.

In 1904 he was made a Fellow of the Royal Society, and was put on the board of the National Physical Laboratory, to whose Director he ultimately yielded the custody of the electrical standards of capacity, which he had watched over and maintained with anxious care. But a slight stroke of paralysis in 1909 caused additional weakness of body. The war was a still further strain, and he felt acutely his inability to serve the country as he earnestly desired. On the 13th December, 1920, he passed quietly away, his remains being laid in the family grave at West Norwood.

He was a man who achieved much under exceptional bodily disabilities; and his devotion to accuracy was of great service in the development of cable telegraphy. His instruments were beautifully designed and constructed, and all measurements were made and recorded with scrupulous care. His character was of the highest, and by his friends he was much beloved; while the pertinacious enthusiasm with which he had overcome difficulties sufficient to daunt ordinary men could not fail to arouse feelings of admiration even among those who but slightly knew him. In 1891 a severe attack of influenza left him permanently lame, and for years subject to acute pain, of which few outside his home knew, so well did he conceal it.

He married Mary Elizabeth, daughter of Mr. William Blomfield, of Upper Norwood, in 1893.

O. J. L.

William Cedling